CSC110 Fall 2021: Term Test 1, Question 2 (Predicate Logic)

Jamie Yi

Wednesday October 20, 2021

Let A be the set of all animals and all plants. Suppose we define the following predicates:

- $Plant(x)$: "x is a plant", where $x \in A$.
- $Omnivore(x)$: "x is an omnivore", where $x \in A$.
- $Herbivore(x)$: "x is a herbivore", where $x \in A$.
- $IsColourful(x)$: "x is colourful", where $x \in A$.
- $Eats(x, y)$: "x eats y", where $x, y \in A$.

(An omnivore is an animal that eats food of both plant and animal origin. A herbivore is an animal that only eats plants.)

For parts (1) to (3), translate each of the following statements from English into symbolic predicate logic. In part (4), you will translate an English statement into Python code.

No explanation is necessary. Do not define any of your own predicates or sets.

Use parentheses to indicate how you want to group logical expressions with multiple operators (especially when dealing with $\Rightarrow$ and $\Leftrightarrow$).

1. At least one plant is colourful.

   Solution:

   $\exists x \in A \text{ s.t. } IsColourful(x) \land Plant(x)$

2. Omnivores eat any animal or plant.

   Solution:

   $\forall x, y \in A,\ (Omnivore(x)) \Rightarrow (Eats(x, y))$

3. At least one herbivore does not eat colourful plants.

   Solution:

   $\forall x \in A, \exists y \in A \text{ s.t. } (IsColourful(x) \land Plant(x)) \Rightarrow (Herbivore(y) \land \neg Eats(y, x))$

4. Suppose we define the following in Python:

   - A variable `animals_and_plants` which represents a set of animals and plants.
   - Functions `is_herbivore` and `eats` that take in argument values from `animals_and_plants`, and correspond to the predicates $Herbivore$ and $Eats$, respectively, defined at the top of this question.
   - A variable `brussel_sprouts` that refers to the plant brussel sprouts. (Note: `brussel_sprouts in animals_and_plants` is True)

Using these definitions, translate the following statement into a Python expression:

> All herbivores eat brussel sprouts.

You must use a comprehension in your solution, and may not use any loops.

```
all([eats(h, bs) for h in animals_and_plants for bs in animals_and_plants
    if is_herbivore(h) if bs == brussel_sprouts])
```

SUBMIT THIS FILE AND THE GENERATED PDF q2.pdf FOR GRADING